

CLAIMS

1. A method of producing a tool (2, 3, 124, 125) intended for the forming of a material, in particular by hot drawing or injection molding, for the purpose of making an object (1, 126) of defined shape therefrom, said tool (2, 3, 124, 125) having to have for this purpose a forming face (16, 88, 133, 134) of shape complementary to at least one portion of said defined shape, said method including an initial step a) that consists in designing a contour of the tool (2, 3, 124, 125) to be produced, which has a projected forming face having said complementary shape, and in devising, on the inside of said projected contour, according to said complementary shape, a projected circuit (13, 14, 142, 143) for the circulation of a heat-transfer fluid inside the tool (2, 3, 124, 125) to be produced, said projected circuit (13, 14, 142, 143) comprising a plurality of projected ducts (18, 23, 27, 30, 32, 96, 97, 102, 108, 115, 144, 145, 146, 147, 150, 153), at least one of which constitutes a projected manifold (18, 27, 32, 96, 97, 102, 144, 145, 146, 147) and at least one other of which constitutes a projected branch (23, 108, 115, 150, 153) off the projected manifold (18, 27, 32, 96, 97, 102, 144, 145, 146, 147) and running alongside the projected forming face (16, 88, 133, 134),

characterized:

- in that the initial step a) is implemented by placing at least a projected first duct (24, 27, 32, 96, 97, 105, 150, 153) over as simple as possible an average surface (28, 29, 33, 98, 103, 154, 155), the average surface (28, 29, 33, 98, 103, 154, 155) of the or each projected first duct (24, 27, 32, 96, 97, 105, 150, 153) intersecting the projected forming face (16, 88, 133, 134), thereby defining sections of the projected forming face (16, 88, 133, 134), and of at least one projected second duct (18, 25, 108, 115, 144, 145, 146, 147), thereby defining sections of the or each projected second duct (18, 25, 108, 115); and

- in that the method then comprises the succession of steps consisting in:

- b: producing tool slices (35, 36, 39, 40, 71, 73, 74, 156, 157), each of which is bounded in particular by at least one mating face, at least certain mating faces (41, 42, 47, 48, 49, 40, 77, 78, 83, 84, 160, 161) at least approximately reproducing a respective average surface (28, 29, 33, 98, 103, 154, 155), namely, acrosswise, by two mating faces (48, 49, 160, 161) at least approximately reproducing, respectively, each of the two respective average surfaces (28, 33, 154, 155), and by at least one

blank for a useful face reproducing a respective projected forming face section (16, 88, 133, 134) adjacent said respective average surface, namely, in a spanning manner, a projected forming face section (16, 88, 133, 134) bounded by said respective two average surfaces (28, 33, 154, 155), and includes, on the one hand, within its thickness, a passage (53, 57, 62, 63, 112, 113, 115, 116, 158, 159) reproducing the respective section of the or each projected second duct (18, 25, 108, 115, 144, 145, 146, 147) and emerging in the or each mating face (41, 42, 47, 48, 49, 50, 77, 78, 83, 84) and, on the other hand, in the or each mating face (41, 42, 47, 48, 49, 50, 77, 78, 83, 84), a groove (51, 52, 56, 58, 59, 96, 97, 100, 104, 105, 157) connected as a branch off said passage (53, 57, 62, 63, 112, 113, 115, 116, 158, 159) and at least approximately reproducing one half of the respective projected first duct (24, 27, 32, 96, 97, 105, 150, 153),

c: juxtaposing the tool slices (35, 36, 38, 39, 40, 70, 71, 73, 74, 156, 157) via their mating faces (41, 42, 47, 48, 49, 50, 77, 78, 83, 84) and mutually fastening them in a relative position in which the useful faces or said blanks, the passages (53, 57, 62, 63, 112, 113, 115, 116, 158, 159) and the grooves (51, 52, 55, 56, 58, 59, 96, 97, 100, 101, 104, 105, 157) are complementary from one slice

(35, 36, 38, 39, 40, 70, 71, 74, 156, 157) to the other slice in order to constitute, respectively, the forming face or a forming face blank (16, 88, 133, 134), the or each second duct (18, 25, 108, 115, 144, 145, 146, 147) and the or each first duct (24, 27, 32, 96, 97, 105, 150, 153), and, where appropriate, machining the forming face blank in order to produce the forming face (16, 88, 133, 134).

2. The method as claimed in claim 1, characterized in that said initial step is implemented by giving the or each average surface (28, 29, 33, 98, 154, 155) and the or each mating face (41, 42, 47, 48, 49, 50, 77, 78, 83, 84, 160, 161) an at least approximately plane shape.

3. The method as claimed in claim 2, characterized in that, in the case of a plurality of said average surfaces (28, 29, 33, 98, 103, 154, 155) and of said mating faces (41, 42, 47, 48, 49, 50, 77, 78, 83, 84, 160, 161), said initial step a) is implemented by orienting said average surfaces (28, 29, 33, 98, 103, 154, 155) and said mating faces (41, 42, 47, 48, 49, 50, 77, 78, 83, 84, 160, 161), respectively, so as to be at least approximately parallel to one another.

4. The method as claimed in any one of claims 1 to 3, characterized in that said initial step is implemented by giving each projected second duct section (18, 25, 108,

115, 144, 146, 147) a straight shape or a V shape defined by two angularly offset straight arms.

5. The method as claimed in any one of claims 1 to 4, characterized in that, when, in the case of an object (126) having the shape of a beam or a similar shape, elongate along a defined longitudinal direction (127), the initial step a) is implemented by giving the projected forming face (133, 134) a shape elongate along a defined longitudinal direction, the initial step a) is also implemented by orienting the or each projected manifold (144, 145, 146, 147) at least approximately longitudinally and by orienting the or each projected branch (150, 153) and the or each average surface (154, 155) at least approximately transversely and by choosing, as projected first duct (150, 153), the or each projected branch (154, 155) and, as projected second duct (144, 145, 146, 147), the or each manifold (144, 145, 146, 147), and step b) is implemented by orienting the or each mating face (160, 161) and the or each groove (157) at least approximately transversely and by orienting the or each passage (158, 159) at least approximately longitudinally.

6. The method as claimed in any one of claims 1 to 4, characterized in that, when, in the case of an object (1) having the shape of a pot or a similar shape, going around

a defined longitudinal axis (4), the initial step a) is implemented by giving the projected forming face (16, 88) a shape going around a defined longitudinal axis (4), the initial step a) is also implemented by orienting the or each projected branch (25, 108, 115) at least approximately longitudinally and orienting the or each projected manifold (27, 32, 96, 97, 102) and the or each average surface (28, 33) at least approximately transversely and by choosing, as projected first duct (27, 32, 96, 97, 102), the or each projected manifold (27, 32, 96, 97, 012) and, as projected second duct (25, 108, 115), the or each projected branch (25, 108, 115), and step b) is implemented by orienting the or each mating face (47, 49, 77, 83, 84) and the or each groove (55, 56, 58, 59, 96, 97, 100, 104, 105) at least approximately transversely and by orienting the or each passage (53, 57, 112, 113, 115, 116) at least approximately longitudinally.

7. The method as claimed in any one of claims 1 to 6, characterized in that the tool slices (35, 36, 37, 38, 39, 40, 69, 70, 71, 72, 73, 74, 156, 157) are produced, during step b), by machining in a preexisting block of thermally conductive raw material.

8. The method as claimed in claim 7, characterized in that said raw material is chosen from a group comprising

Al₂O₃-copper alloys, cadmium copper alloys, beryllium copper alloys and stainless steels.

9. A tool intended for the forming of a material, in particular by hot drawing or injection molding, for the purpose of making an object (126) of defined shape therefrom, said tool (2, 3, 124, 125) having for this purpose a forming face (16, 88, 133, 134) of shape complementary to at least one portion of said defined shape, and an internal circuit (13, 14, 142, 143) for the circulation of a heat-transfer fluid, said circuit (13, 14, 142, 143) comprising a plurality of ducts (18, 23, 27, 30, 32, 96, 97, 102, 108, 115, 144, 145, 146, 147, 150, 153), at least one of which constitutes a manifold (18, 27, 32, 96, 97, 102, 144, 145, 146, 147) and at least one other of which constitutes a branch (23, 108, 115, 150, 153) off the manifold (18, 27, 32, 96, 97, 102, 144, 145, 146, 147) and running alongside the forming face (16, 88, 133, 134),

characterized in that it consists of a bonded assembly of tool slices (35, 36, 38, 39, 40, 70, 71, 73, 74, 156, 157) mutually juxtaposed by mating faces, at least certain (41, 42, 47, 48, 49, 50, 77, 78, 83, 84, 160, 161) of which coincide at least approximately with as simple as possible an average surface (28, 29, 33, 98, 103, 154, 155), of a first duct (24, 27, 32, 96, 97, 105, 150, 153), and which

intersect the forming face (16, 88, 133, 134), thereby defining forming face sections, and of at least one second duct (18, 25, 108, 115, 144, 145, 146, 147), thereby defining second duct portions.

10. The tool as claimed in claim 9, characterized in that the or each mating face (41, 42, 47, 48, 49, 50, 77, 78, 83, 84, 160, 161) and the or each average surface (28, 29, 33, 98, 103, 154, 155) are at least approximately plane.

11. The tool as claimed in claim 10, characterized in that said mating faces (41, 42, 47, 48, 49, 50, 77, 78, 83, 84, 160, 161) and said average surfaces (28, 29, 108, 115, 144, 145, 146, 147) are respectively at least approximately parallel to one another.

12. The tool as claimed in any one of claims 9 to 11, characterized in that each second duct section (18, 25, 108, 115, 144, 145, 146, 147) has a straight shape or a V shape defined by two angularly offset straight arms.

13. The tool as claimed in any one of claims 9 to 12, characterized in that, when, in the case of an object (126) having the shape of a beam or a similar shape, elongate along a defined longitudinal direction (127), the forming face (133, 134) has a shape elongate along a defined longitudinal direction (127), the or each mating face (160,

161) and the or each average surface (154, 155) are at least approximately transverse, the or each first duct (150, 153) is at least approximately transverse and constitutes a branch (150, 153) and the or each second duct (144, 145, 146, 147) is at least approximately longitudinal and constitutes a manifold (144, 145, 146, 147).

14. The tool as claimed in any one of claims 9 to 12, characterized in that, when, in the case of an object (1) having the shape of a pot or a similar shape, going around a defined longitudinal axis (4), the forming face (16, 88) has a shape going around a defined longitudinal axis (4), the or each mating face (47, 48, 49, 77, 78, 83, 84) and the or each average surface (28, 33) are at least approximately transverse, the or each first duct (27, 32, 96, 97, 102) is at least approximately transverse and constitutes a manifold (27, 32, 96, 97, 102), and the or each second duct (25, 108, 115) is at least approximately longitudinal and constitutes a branch (25, 108, 115).

15. The tool as claimed in any one of claims 9 to 14, characterized in that each tool slice (35, 36, 37, 38, 39, 40, 69, 70, 71, 72, 73, 74, 156, 157) results from machining in a block of thermally conductive raw material.

16. The tool as claimed in claim 15, characterized in that said raw material is chosen from a group comprising

Al₂O₃-copper alloys, cadmium copper alloys, beryllium copper alloys and stainless steels.

17. The tool as claimed in any one of claims 9 to 16, characterized in that it constitutes a hot-drawing tool chosen from a group comprising punches (2, 124) and dies (3, 125).

18. The tool as claimed in any one of claims 9 to 16, characterized in that it constitutes one component of an injection-molding mold.